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from the Point of View of Physical
Training.*

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FOOT-BALL AND THE PHYSIQUE OF ITS DEVOTEES, FROM THE POINT OF VIEW OF PHYSICAL TRAINING.¹

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THE object of physical training, as understood at the present day, is the normal symmetrical growth and development of the human body by means of a carefully selected system of graded and progressive exercise. The exercises may be divided into general and special, the former being applicable to classes and the latter to individuals according to their special individual needs. In the smaller colleges and schools the instructor in gymnastics superintends both forms of exercise, but in the larger ones a medical director takes charge of the special exercises, which are prescribed only after a most careful examination, such as only a well-educated physician can make. The exercises themselves are, for the most part, done in a gymnasium; certain games for children are played in the open air, as in the German system of gymnastics.

It seems to me that no two things are so often confounded as this system of regular exercises, taken in the gymnasium, and the practice of athletic sports. The drills in the gymnasium compare with athletic training about as the undergraduate course at a college compares with the post-graduate course. The management of the former is in the hands of a responsible medical superintendent, that of the latter in the hands of an irresponsible (medically speaking) athletic committee composed mainly of ex-champions of the field. Systematized and supervised gymnasium exercise treats the body as a whole, and is perhaps less interesting to the partakers of it; athletic sports develop special parts to a high degree of perfection and are to some very attractive, but need corrective exercises to re-establish perfect symmetry of development, which is the object of systematized physical training.

History shows that the one great danger of all athletic sports is in their being carried too far, and a reaction in public opinion is the natural and inevitable result. Thus, some of our most prominent men and educators, as well as physicians of America and England, have quite recently placed their names on record as being very much against the *present tendencies* of some of our athletic sports, notably those of football.

¹ Read before the American Physiological Society.

Among the medical papers, especially have the *Medical News* and the London *Lancet* repeatedly commented on the game of foot-ball and on the number of deaths and of serious injuries directly traceable, not, as I understand them, to the game itself, but to the evils accompanying it.

By still others it is even held that foot-ball has ceased to be a gentleman's game, and that the modern foot-ball player, playing, as some do for gate-money and other pecuniary rewards, stands on about the level of the professional prize-fighter, acrobat, India-rubber man, and other freaks.

On the other hand, according to its enthusiasts the game of foot-ball is by far the greatest ever invented—that such things as pluck, self-reliance, self-control, temperate habits, soldierly qualities, and discipline of any kind were unknown in the world before its introduction; we are quite *ex cathedra* informed that all these good and manly qualities can be properly developed only through the medium of foot-ball.

There being a great deal of truth and a great deal more of error and of exaggeration on both sides of this controversy, the question is, How much of this war of words is based on facts and how much on mere opinion?

Medical papers, unlike other newspapers, are published for but one class of people, namely, physicians, who are the natural guardians of public health and in whose direct line of duty it seems to lie to call timely attention to any danger threatening life and limb from any direction or cause whatsoever. When, then, the London *Lancet* for 1892 reports one hundred and nine grave injuries, among which were noted three cases of concussion of the brain, twenty collar-bone fractures, twenty-nine fractures of legs, five compound fractures, six fatal abdominal injuries, with a total number of twenty-three deaths; when, furthermore, the *Medical News* reports five cases of death as having occurred in this country in 1893, due to foot-ball, any medical man would consider these statements well authenticated, and without hesitation would put them down as facts, reasoning from the standing of these two medical papers, for any necessity for their either suppressing or enlarging the facts does not exist; it is, on the contrary, much to their interest to publish simply the naked truth.

Granted though it must be that it would have been much better and more satisfactory if the collectors of the above facts had, at the same time, counted the total number of players of England and America, and also if they had taken the trouble to furnish us with brief but concise accounts of all the circumstances surrounding at least the deaths that have occurred—in other words, if the statistics had been more carefully taken—yet, from the above-mentioned data, so far as they go, it

would nevertheless follow that the game of foot-ball as played at the present time is attended by a considerable number of injuries and even by a certain number of deaths; the percentage number of the latter, however, would certainly look rather diminutive if the total number of players were actually known.

These, then, are some of the admitted facts that form the basis for argument against the game, and that are now agitating the public mind as well as the minds of college faculties.

Turning to the other side of this question, if we examine the foundations for the argument in *favor* of the game of foot-ball, the absence of solid facts becomes at once most apparent. It is positively discouraging when one realizes the large amount of writing extant upon foot-ball events and upon the game itself, and the time that the student of these matters is compelled to expend in reading these accounts—without, in the end, finding himself rewarded with one single solid substantiated fact or result, except those existing for the most part in the imagination of over-enthusiastic advocates of the game, and which are consequently neither ponderable nor measurable, but a fine and highly refracting collection of rhetorical soap-bubbles that will not stand critical examination.

It would seem, so far at least, as if the opponents of foot-ball had the advantage of the argument, and it now becomes the duty of the friends of the game who would like to see it perpetuated to produce, if possible, *facts* that are calculated to neutralize the disadvantages alleged. The foot-ball season with all its excitement being over for the time being, the opportunity for considering the arguments pro and con seems too favorable to be allowed to pass. Let us, therefore, see what are the facts that would argue in favor of the game from the point of view of physical training.

In the autumn of 1892 we determined to make some observations on the influence of foot-ball as an out-of-door exercise on the human physique, so far as that influence can be ascertained by certain anthropometric measurements, taken on the players, at certain definite intervals of time. In order to obtain a standard for a beginning, we tried to measure a few of the visiting "teams" as well as our own. We, very soon, however, were made most painfully aware of the great difficulty of our task from more than one point of view. In the first place, it was found to be an unusually difficult undertaking to attempt to induce a visiting foot-ball "team," solicitous about the result of the contemplated match game, to submit to being measured to the extent that is necessary for obtaining accurate and valuable results an hour or so before the game begins. It is simply useless to inform them that it cannot possibly hurt a man in training for foot-ball to squeeze and pull about a few manometers. In the second place, whatever was done had

to be done quickly, and the danger of all quick work is that accuracy must be more or less sacrificed.

For these two reasons we deem ourselves rather fortunate in, nevertheless, succeeding in getting the measurements of five visiting "teams," the success being almost entirely due, rather to the winning and persuasive ways of some of my more diplomatic associates on the athletic committee than to my own efforts.

Inasmuch as our work in this direction is believed to possess a certain definite value not only as regards the subjects of physical training and anthropology but also as regards the present foot-ball question, the publication of some of the results seems both desirable and timely.

The points that were more especially taken notice of were the age, height, weight, lung-capacity, and "total strength" of each individual player, and the position which he occupied on the field.

Table I. is intended to give but the averages of each eleven on the different "teams" named:

TABLE I.

Names.	Age.	Height.	Weight.	Lung capacity.	Total strength.	Time of measurement.
	Yrs. mos.	Mm.	Kilo.	Litre.	Kilo.	1892
University of Pennsylvania	22	1810	80	4.604	624	Oct. 12
Princeton	20 8	1800	80.9	4.883	730.5	" 15
Lafayette	20	1760	77	4.260	642	" 22
Franklin and Marshall	22 4	1720	73	4.112	602	" 29
Rutgers	20 7	1780	77	4.833	686	Nov. 5
U. S. N. Academy	20	1780	73	5.094	730	Oct. 21
U. S. N. A. "Hustlers"	19	1760	71	4.456	617	" 21
Averages (French)	20 8	1773	76	4.557	662	} No. of observ. 77
Averages (English)	20 8	69.8 in.	167 lbs.	278 cb.in.	1456 lbs.	

The French system of weights and measures is now almost exclusively used in anthropometry, but for the convenience of the English reader the averages have been converted into the English system. The only item needing a more detailed description for an intelligent understanding of this and the succeeding tables is the "total strength." The total individual strength was included in our observations from the quite natural inference that the game under consideration is one in which the strong and hearty are much more apt to engage than those less plentifully endowed by Nature as regards the size and quality of their muscles. An account of the method of ascertaining this total strength will, therefore, be given under the head of "total strength."

It will be noticed in Table I., by the names of the teams there represented, that several of the larger universities and colleges, as well as some of the smaller ones, are included. The two naval teams may,

perhaps, be considered as standing between these two classes. The combined averages of the seventy-seven players, consequently, ought perhaps to answer pretty nearly to the description of the average American football player as he is at present. The table represents a great deal of labor in a small space, and contains in many respects a great deal of information not apparent at first sight, but, before analyzing it further, let us turn our attention to some other observations, and consider in detail the changes that were produced in the different items under observation by a course of foot-ball training, lasting, as it does here at the Naval Academy, two months.

1. HEIGHT. As regards height, I may at once dismiss this item by stating that there never was any appreciable change produced in it during the above-mentioned period of two months' training, and the heights are given in the tables for reasons that will become more apparent as we proceed. I must add that I do not wish to be understood by this statement as asserting that the height of foot-ball players is never changed during the training period, but merely that, so far as these observations have extended, such changes have not been observed. Growth in height, however, does not stop in those having undergone training who are still of an age at which development cannot have been completed, for I have observed it to take place after the period of foot-ball training was over.

2. WEIGHT. As regards the influence of foot-ball on the weight of the players, a most decided increase has been noticed. The average increase in weight which was observed and calculated from seventeen players, examined in the fall of 1892, immediately before and after the period of training, with regard to this point, was found to be 3.6 kilos, or 7.9 pounds. The same observations being repeated on twenty-five players in the fall of 1893, resulted in showing an average increase of 3.28 kilos, or 7.2 pounds.

Expressed in percentage, the average increase of the seventeen players examined in 1892 was 4.9 per cent. of their original weight, and in 1893, in the twenty-five players under observation, it amounted to 4.7 per cent. of their original weight, as the "weight" column of Table II. will show.

3. LUNG-CAPACITY. There is perhaps not one single subject in connection with physical training upon which more stress is laid by the more experienced men in this field than the necessity of developing the lung-capacity. The capability of drawing a sufficient amount of oxygen into the system to supply at all times, and under all conditions and circumstances, the amount necessary for the full performance of the various functions of all the living cells in the system must ever be looked upon as a condition *sine qua non* to be aimed at by the physical trainer. The amount of oxygen that an individual is capable of absorbing into

TABLE II.—INFLUENCE OF TWO MONTHS' EXERCISE AT FOOT-BALL ON THE WEIGHT AND LUNG-CAPACITY OF 25 PLAYERS.

Observations in October and November, 1893.

No.	Age.	Height.	L. cap. i.	L. cap. ii.	Gain.	Weight, i.	Weight, ii.	Gain.
	Yrs. mos.	Mm.	Litres.	Litres.		Kilo.	Kilo.	Kilo.
1	19 6	1740	4.58	4.75	...	70	72	2
2	19 10	1832	5.73	6.22	...	75	80	5
3	21 6	1750	4.07	4.26	...	70	75	5
4	21 0	1812	4.26	4.34	...	65	64	-1
5	19 0	1738	4.45	4.45	...	70	70	0
6	21 3	1688	4.26	4.45	...	65	67	2
7	17 8	1690	4.45	4.50	...	71	71	0
8	20 3	1673	3.94	4.07	...	59	62	3
9	21 3	1696	4.26	4.45	...	62	66	4
10	20 0	1740	4.45	4.45	...	70	76	6
11	19 2	1730	4.26	4.45	...	64	70	6
12	18 1	1828	3.94	4.26	...	71	73	2
13	19 9	1752	3.94	4.07	...	76	80	4
14	19 9	1780	4.50	4.91	...	67	70	3
15	19 6	1802	4.58	5.07	...	75	80	5
16	17 9	1754	4.07	4.26	...	75	80	5
17	22 0	1690	5.57	5.73	...	76	80	4
18	21 1	1805	5.32	5.57	...	67	70	3
19	21 10	1780	4.91	4.91	0	70	75	5
20	19 6	1730	5.57	5.90	...	74	80	6
21	18 1	1858	4.58	4.91	...	69	73	4
22	20 6	1762	3.76	4.45	...	73	75	2
23	17 6	1781	4.07	4.45	...	74	76	2
24	22 4	1828	4.58	4.58	0	68	70	2
25	20 2	1720	4.07	4.45	...	67	70	3
Av. (French)	19 11	1758	4.53	4.71	0.18	69.72	73	3.28
Av. (English)	19 11	69.2 in.	277 cb.in.	288 cb.in.	11 c. i.	153.3 lbs.	161 lbs.	7.7 lbs.

his system being largely dependent on the amount of air he will be capable of inhaling in a given time, or in one inspiration, we naturally turn to his lung-capacity, as ascertained by the spirometer, for points regarding his enduring qualities.

On October 15, 1892, the first examination of seventeen players was made with regard to their lung-capacities, and at the end of November the second examination was made. The result of these two examinations was quite surprising, for all the men, except two, came back with the same lung-capacity on their second examination that they had shown on their first. The only increase that had taken place was noted in two half-backs—who, as is well known, have to do a great deal of running during the game. Thinking that it was possible that the lung-capacity increased in the beginning of the period of training, and that I ought to have taken my first observations on the 1st instead of on the 15th of October, the same observations were repeated this year (1893) on twenty-five players. The results are likewise shown in Table II., where it will be seen that the twenty-five players, after a two months' course of training on the foot-ball field, give us an increase in lung-capacity of eleven cubic inches, or an average increase of 3.9 per cent.

of their original lung-capacity. Notice, however, that the percentage amount of increase in weight is 0.8 higher than that of the lung-capacity, a circumstance of some weight in its relation to the subject of "vital index," or the result of a simple division of lung-capacity by weight, and to which we shall again refer later on.

4. **TOTAL STRENGTH.** According to the *Anthropometric Manual* of Amherst College, published in 1893, by Drs. E. Hitchcock and H. H. Seelye, the tests to be taken of a person whose total strength is to be calculated are as follows:

a. Expiratory strength. The subject, after loosening the clothing about the chest and filling the lungs completely, should blow with one blast into the spirometer. Care should be taken that no air is allowed to escape from the sides of the mouth, and that in expelling the air all the muscles of expiration are brought into play.

b. Strength of back. The subject standing upon the foot-rest—as shown in Fig. 1, but with the legs straight—and with the dynamometer so arranged that when grasping the handles with both hands his body will be inclined forward at an angle of 60° , should take a full breath, and, without bending his knees, give one hard lift, mostly with his back.

c. Strength of legs. The subject, while standing on the foot-rest, with body and head erect, and chest thrown forward (see Fig. 1), should sink down by bending the knees, until the handle grasped rests against the thighs, then, taking a full breath, he should lift hard, principally with the legs, using the hands to hold the handle in place.

d. Strength of upper arms (triceps). The subject, while holding the position of rest upon the parallel bars (see Fig. 2), supporting his weight with arms straight, should let the body down until the chin is level with the bars, and then push it up again until the arms are fully extended. Note the number of times that he can lift himself in this manner.

e. Strength of upper arms (biceps). The subject should grasp a horizontal bar or pair of rings, and hang with the feet clear from the floor, while the arms are extended. Note the number of times that he can haul himself up until his chin touches the bar or rings. (See Fig. 3.)

f. Strength of forearms. (See Fig. 4.) The subject, while holding the dynamometer so that the dial is turned inward, should squeeze the spring as hard as possible, first with the right hand, then with the left.

The total strength is obtained by multiplying the weight of the subject by the sum of the "dip," *d*, and the "pull," *e*. (This is divided by 10 simply to prevent too great a number of figures in the calculation.) To this is added the strength of back, the strength of legs, the average of the forearms, and the lung-strength, *a*. The sum is the "total strength."

For example: The weight of the subject being 64 kilos, the "dip" 11, and the "pull" $12 = 23$; the back-strength 150, and the leg-strength

180, the forearm-strength 45, and the lung-strength 2, the result will be $64 \times 23 \div 10 + 150 + 180 + 45 + 2 = 524$.

FIG. 1.¹



FIG. 2.

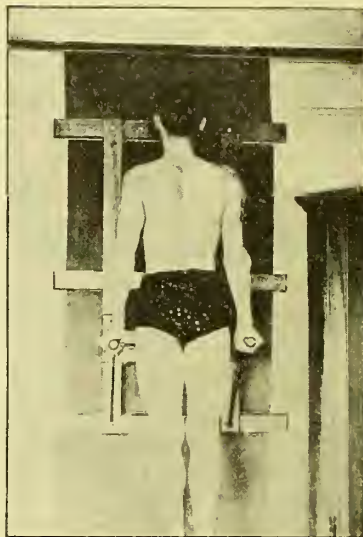


FIG. 3.

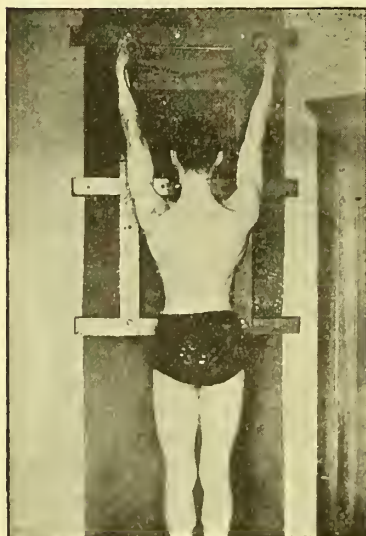


FIG. 4.



This method, as will be noticed, is not intended to give us the exact amount of work that an individual is capable of doing, and which is

¹ These illustrations are used by permission from *Physical Education*.

calculated after a different manner,¹ but rather the total amount of available energy or strength which a person may bring to bear upon an obstacle at any given moment; in other words, it leaves us for the moment in ignorance as regards the endurance.

Table III. exhibits the observations of the last two years and their results. The average increase in total strength of the seventeen players examined in the fall of 1892 was 105 kilos, or about 16.4 per cent. of their original strength, and that of the fifteen players noted in the fall of 1893 amounted to 85 kilos, or 14.2 per cent. of their original strength. On examining more closely into the distribution of this increase in strength we have found that about 75 per cent. of it extends over the lower extremities and the back, showing that, although all the muscles are engaged in playing the game, there is a quantitative difference of degree.

TABLE III.—INFLUENCE OF FOOT-BALL PRACTICE ON THE TOTAL STRENGTH OF THE PLAYERS.

No.	17 players, av. age 19 yrs. 6 mos. av. height 1765 c.m. or 69.5 in. Observation in 1892.			15 players, av. age 20 yrs. 6 mos. av. height 1763 c.m. or 69.4 in. Observation in 1893.		
	Total strength in kilos.			Total strength in kilos.		
	First exam.	Second exam.	Gain.	First exam.	Second exam.	Gain.
1	648	689	41	572	616	44
2	758	801	43	567	616	49
3	654	703	49	598	685	87
4	621	672	51	785	793	8
5	648	700	52	478	580	102
6	746	832	86	525	686	161
7	521	608	87	724	815	91
8	692	790	98	590	709	119
9	543	649	106	718	780	62
10	753	860	107	631	724	93
11	500	612	112	515	611	96
12	852	974	122	604	686	82
13	500	630	130	666	696	30
14	504	635	131	420	588	168
15	664	836	172	565	648	83
16	692	884	192			
17	626	824	196			
Averages . . .	642	747	105	597	682	85

In the beginning of the last foot-ball season I examined about forty players with the view of getting a larger number for the second examination. But—as a glance at the number of tests that must necessarily be taken of each individual, in order to accurately calculate from the facts thus ascertained his total strength, will show—the individual must be in perfect condition at the time of examination. Bruised hips, knees, ankles, shoulder-joints, elbow- or wrist-joints, and even finger-

¹ See Report of the Surgeon-General of the Navy, 1893, p. 150.

joints, will make accurate tests impossible; and hence the larger number of them—some of the best among them—could not be examined a second time immediately after the close of the season, and had to be thrown out of our observations to make the remaining ones as nearly-accurate as is possible under the circumstances. Here is another reason why it is so difficult to obtain large numbers of observations in this field, and which also may largely account for the fact that no observations of this nature made at some of the other colleges of the United States have, at least up to the present, come to my notice.

Attention has already been called to the "vital index" (Enebuske) as having a certain significance in relation to the results obtained by physical training. The vital index is obtained by dividing the lung-capacity of a person as ascertained by means of the spirometer, and expressed in litres, by his weight in kilos. Démény, in France, from his studies on children, found that in those of the same age the lung-capacity was proportioned to their weight, and that if a curve were constructed of lung-capacity and weight in relation to age, the two curves come out parallel.

Démény found, furthermore, that this ratio was much higher in persons having undergone systematic physical training than in those who had not. These studies of Démény have been repeated in a measure by Enebuske, and their correctness in his hands appears to have received additional support. Démény, quoted by Enebuske,¹ makes this statement regarding the index: "By taking young gymnasts and arranging them according to the decreasing value of their ratio of lung-capacity and weight, we have been able to ascertain that thereby we have made a classification that corresponds sensibly to their degree of resistance."

From our own limited experience with this index we believe it will be found correct for the large majority of cases.

Before leaving the subject of total strength, I must add what appears to me to be a point of considerable interest. It might quite naturally occur to the reader that this so rapidly acquired strength was but a temporary affair, and would vanish again as quickly as it was acquired. As I was myself under this impression, I searched my records, and found that I was somewhat mistaken. In the seventeen players of last fall (1892) the maximum loss six months after the close of the season was only 5 kilos, or less than 1 per cent. Thus, no matter what we may find with regard to the staying qualities of the strength acquired through other sports, foot-ball strength, according to these observations, seems to stay pretty well.

SUMMARY.—In summing up the facts ascertained in the above observations, we obtain as a result of two months' foot-ball training on the

¹ Observations on the Results of Pedagogy-Gymnastics of the Ling System, made at the Boston Normal School of Gymnastics, Boston, 1893.

seventeen players examined in the fall of 1892: (1) No increase in height, (2) no increase in lung-capacity, (3) an average increase of 4.9 per cent. in weight, and (4) an average increase of 16.4 per cent. in total strength. In the twenty-five players examined in the fall of 1893 we get: No increase in height, an average increase of 4.7 per cent. in weight, an average increase of 3.9 per cent. in lung-capacity, and an average increase of 14.2 per cent. in total strength (17). In both series of observations we have to record a decrease in vital index.

It now becomes clear that in order to form any proper conception as to whether foot-ball is an exercise superior, inferior, or equal to any other form of exercise, we would require a similar set of observations made on the devotees of base-ball, cricket, lawn-tennis, boating, or any other out-of-door exercise, for the purpose of making comparisons. In this respect, however, the literature on physical training is sadly and most painfully deficient; there are, among the large number of books written on the subject, no published accounts with which to make such comparisons. The most we can do at present, therefore, is to form an approximate idea deduced from a comparison of these results with those obtained in the gymnasium. But even here we meet with almost the same scarcity of published results, and thus we cannot escape coming to the conclusion that the much-vaunted benefits derived from athletic as well as gymnastic exercise, *for all we know or can get at*, exist for the most part in the minds of physical trainers, and perhaps in the personal feelings of those who have taken such exercises. Although this may form quite sufficient evidence for some, it will nevertheless not do for the purpose of establishing an incontrovertible fact, as it ought to be established, on sufficient scientific grounds. Science, unfortunately for some, requires proof; opinions may content themselves with faith.

But, the paucity of scientific data to the contrary notwithstanding, we all have at least a very strong suspicion that all forms of exercise, especially the out-of-door ones, do produce good results, not only with regard to their influence on the physique, but also on the mind, the discussion of which, however, from the nature of this inquiry, does not come within the scope of our paper.

In some studies made on fifty naval cadets, and published in the report of the Surgeon-General of the Navy for 1893, the following average increases were noted as a result of six months' systematized exercise in the gymnasium, viz.: 0.5 per cent. in height, 1.3 per cent. in weight, 3.8 per cent. in lung-capacity, and 32 per cent. in total strength. The average vital index at the beginning was 0.067 and at the end of the term 0.066, consequently there was a slight decrease. The average age of the fifty cadets was exactly eighteen years.

According to the measurements in our possession of eight oarsmen,

including about two months' hard training for a boat-race during the spring months of 1893, we are enabled to record the following average increases, viz.: 0.2 per cent. in height, 4.7 per cent. in weight, 7.3 per cent. in lung-capacity, and 28 per cent. in total strength. The vital index at the beginning of the period of hard training was 0.066 and at the end it was found to be 0.068; there was, therefore, a slight increase in the latter.

These several items are arranged in the following table:

TABLE IV.

Results of training in	Average Age.		Height.	Weight.	Lung capacity	Total strength	No. of obser.	Time.
	Yrs.	mos.	Per ct.	Per ct.	Per ct.	Per ct.		
1. Foot-ball, 1892	19	6	0	4.9	0	16.4	17	2 months.
2. Foot-ball, 1893	19	11	0	4.7	3.9	14.2	25	2 months.
3. Oarsmen, 1893	19	3	0.2	4.7	7.3	28	8	2 months.
4. Cadets, gym., 1892-3	18	0	0.5	1.3	3.8	32	50	6 months.
5. Cadets, gym., 1893-4	18	0	0.8	1.0	6.5	25.0	74	6 months.

The several methods of training for these sporting events, as well as the system of exercises in the gymnasium pursued nowadays, being so well known, and described elsewhere, a description of them may here be omitted.

The figures shown in Table IV., so far as they may be of value, would lead one to conclude that both the regular systematized gymnasium drill and boating would furnish results superior to those of foot-ball. Boating, considering the large percentage of increase in lung-capacity and total strength which it here shows, must be considered the best training of them all.

Moreover, if we compare the vital index of our average foot-ball player as he appears in Table I., and which is 0.059, with the average vital index of the fifty cadets, which is 0.066, and that of the oarsmen, which is 0.068, the same of the average Yale student being 0.065 and of the average Amherst student 0.061, we find it rather below all of them.

These are the simple unqualified *facts* as to foot-ball. Having now arrived at where we may form at least an approximately true conception of what the results of certain methods of training and exercising are, we must turn our attention to another very important question, and one not to be lost sight of in an inquiry of this character, viz.: Are all the finely-developed young men whom we see in the field at one of our championship games really the result pure and simple of foot-ball play, as is commonly inferred, or might it not also be possible that some of the fine manly qualities which they exhibit have been handed down to them from some not too remote ancestor? In other words, has the foot-ball field exercised a certain *natural selection* in the choice of its

devotees, to complement that of the "coach," or are our fine athletic players indeed creations *de novo* of the foot-ball field alone? And this question must be asked with regard not only to foot-ball but also to all our athletic sports. It so happens that it is, comparatively speaking, much easier to prove that natural selection has by far the biggest share in the furnishing of the foot-ball field with its men; its influence in this instance is, indeed, so apparent and so strongly marked that even without the assistance of craniometric data, the anthropological eye may easily discern an overwhelming preponderance of Anglo-Saxon and Germanic types of men, exhibiting to a large extent the good and characteristic qualities, mental and physical, of their blue-eyed, light-haired, and long-headed ancient ancestry. But we need not alone rely on what we merely see with our eyes, for we have in our possession an abundance of material to show that the sport attracts superior types of men from the very start.

To begin with, let us, for instance, first compare the records of our own foot-ball men with those of the fifty percentile grade cadet, confining ourselves in making such comparison to the same items that have formed the bases of all our previous observations, namely, height, weight, lung-capacity, and total strength.

As shown in Table V.: (1) The average age of the thirty-six foot-ball players is but two months ahead of that of the fifty percentile grade cadet, and represents, therefore, the average cadet so far as age is concerned, in accordance with the fact that players are admitted from all the four classes alike; (2) in height we find the foot-ball-player in average 4 per cent. superior; (3) in weight he is 28 per cent. superior; (4) in lung-capacity 21 per cent., and (5) in total strength 49 per cent. superior to his average fellow.

TABLE V.

	Av. age.	Height.	Weight.	Lung cap.	Tot. str.	No. obs.
	Yrs. mos.					
Fifty percentile cadet . . .	19 7	1697	57	3.58	454	603
Average foot-ball player . .	19 9	1766	73	4.66	676	36
Superiority in per cent.	.....	4	28	21	49	

In the thirty-six players here represented, and of which number alone complete measurements were available for our purpose, there are included but eleven championship players, the remaining ones are those who never will play in a big game and, consequently, fall below the average; besides, nearly all the measurements represent the player as he is at the beginning of the training period, and without the increase noted to take place from the course of training.

But if even we were to take off from this, the percentage superiority, that which we have shown may be gained during a two-months' course of training at foot-ball, it would scarcely perceptibly lessen the former nor tend to make the conclusion less convincing that natural selection is by far the strongest of the two factors in the production of our finely-developed-looking foot-ball devotees.

Nor need we confine our comparisons to the records of the Naval Academy alone, for there is an abundance of material for comparison on hand outside of it.

Let us take, as another instance, the figures of our average American foot-ball man, as shown in Table I., and compare him with the fifty percentile grade of the Yale students, from tables published by Seaver, and compiled from measurements taken during a period of five years.

TABLE VI.

	Av. age.	Height.	Weight.	Lung cap.	Tot. str.	No. obs.
	Yrs. mos.					
Av. American foot-ball player .	20 8	1773	76	4.55	662	77
Yale student, 50 per cent. . .	19 7	1724	63.1	4.13	458 ¹	(5 years)
Superiority in per cent. .	.....	2.8	20	10	44	

We find by a glance at Table VI. that the average American foot-ball player is (1) one year and one month older, (2) 2.8 per cent. taller, (3) 20 per cent. heavier, (4) has 10 per cent. more lung-capacity, and (5) is 40 per cent. stronger than the fifty percentile grade of Yale students.

Making, finally, a similar comparison with the Amherst student of the fifty percentile grade, and using for this purpose the tables but recently published by Drs. Hitchcock and Seelye, we will find, by examining Table VII., a superiority existing similar to that already noticed in previous tables.

TABLE VII.

	Av. age.	Height.	Weight.	Lung cap.	Tot. str.	No. obs.
	Yrs. mos.					
Av. American foot-ball player .	20 8	1773	76	4.55	662	77
Amherst student, 50 per cent. .	22 6	1720	61.7	3.77	482	2230
Superiority in per cent. .	.....	3	23	20	37	

This selective influence is not only shown in the larger boys, but extends, it would seem, also into smaller communities of boys. There are

¹ Computed from insufficient data, but believed to be approximately correct.—H. G. B.

two sets of boys here who have banded themselves together into foot-ball "teams," and if anyone should think that they do not play the regular game in dead earnest, he may come and pay us a visit during the season and investigate for himself.

The smaller team, which we may, for convenience sake, call juvenile team No. 1, consists of boys of an average age of eight years; and on comparing their average height with that of the fifty percentile grade of the Boston school boys¹—of the same, age of course—we find it to be 6 per cent. superior to that of the latter, and in weight they are 3 per cent. superior.

Juvenile team No. 2 consists of boys of an average age of thirteen; their measurements show, on a similar comparison being made, a superiority to the Boston school boys of 3 per cent. in height and 6 per cent. in weight.

We have seen the statement made somewhere that the class-standing of those of the college students who devote themselves to athletic sports is higher than that of those who do not, and the inference is, that the practice of those sports leads directly up to this result. We do not doubt for a moment the absolute correctness of the statement, but the inference may have to be slightly modified, for in view of the above facts we must likewise admit, at least, the possibility of an influence of the principle of selection; this influence admitted, we would rather expect to find what is implied in the above statement as a natural coincidence, than try to explain it on other grounds. We do not doubt in the least that bodily exercise influences the functions of the brain most favorably, but it does this indirectly, for, in order to produce any measurable changes in the quantity and quality of brain work, its influence would have to be much more profound than it is, and be continued for many generations, for the results of thousands of years of Nature's work on mankind are not so easily influenced as to be educated away by an afternoon's practice at foot-ball.

What, now, it may be asked, have we learned from these observations? Do they prove that gymnastic exercise is a mere fad, and that foot-ball is worthless? They do neither; but on the contrary, if they prove anything, they plainly show that, if we have placed our foot-ball ideal unadorned on the balance, we have not found it wanting; and while it cannot be considered the best game in the world, and much of its vaunted superiority is due to popular clamor conjured up by the newspapers, it must, nevertheless, be considered as *one* of the best games extant. Based on these observations, we may feel ourselves on much firmer ground than we did before, if even we have to limit our arguments to the point of physical training alone, and cannot, from the nature of our inquiries

¹ H. P. Bowditch: *Growth of Children*, etc., Boston, 1891.

extend our conclusions to the other manifold beneficial results produced by the game, the investigation of which must be relegated to the psychologist.

On the other hand, if physical training is to stand, do not let us base our conclusions on false premises, for unless we take care that our grounds are true, broad, and deep, a sudden wave of popular indignation may some day cause it to come to a premature end, or, to say the least, seriously impede its onward march!

The question of policy regarding foot-ball, and as to how it should be played and managed in the future, has been so ably discussed by Drs. White, Wood, and Roosa, as well as Presidents Schurman, Angell, and Warfield, that there remains but little to be added to it here.

The greatest danger that threatens foot-ball, by unanimous consent, seems to be the introduction of the professional element into its constitution. This, again, must be looked upon as the direct consequence of newspaper clamor.

Unless, therefore, our college faculties will get together and arrange a special selective course leading up to the degree of Bachelor of Athletics, thus dignifying the game at once as a profession, which, I fear, they are not yet prepared to do, we will have to use a certain amount of discrimination and play foot-ball with more moderation, confine the game to the undergraduates and to the college-campus if it is to continue to live.

But how about the number of injuries and even deaths that have been recorded as having been produced on the foot-ball field? While it must be admitted that accidents may occur here as elsewhere, and in spite of all proper precautions having been taken, it is, nevertheless, probably also true that, were all the circumstances surrounding these cases known, all the recorded deaths, without an exception, would be found traceable to gross carelessness of one kind or another. At any rate, since we cannot eat our pie and have it too, we shall have to pay a certain amount for the good we derive from it; and, if we should find that our investment does not turn out a gold mine, we may be satisfied with a silver one. But, certainly, all the injuries produced on the foot-ball field, in games played between gentlemanly and well-matched players, that have come under our observation have been amenable to treatment and have resulted in perfect cure.

The one precaution mentioned by President Warfield, viz., to make the medical director in charge of physical training omnipotent in excluding boys who are unfit to play in this game by reason of certain physical conditions or injuries existing, cannot be too strongly urged upon college faculties and those who wish to see the game survive.

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